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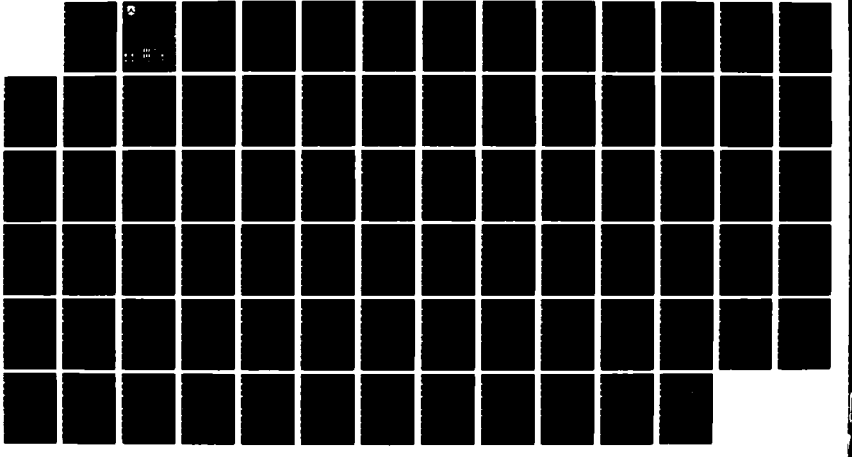
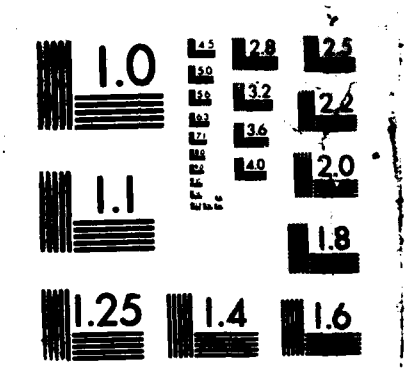




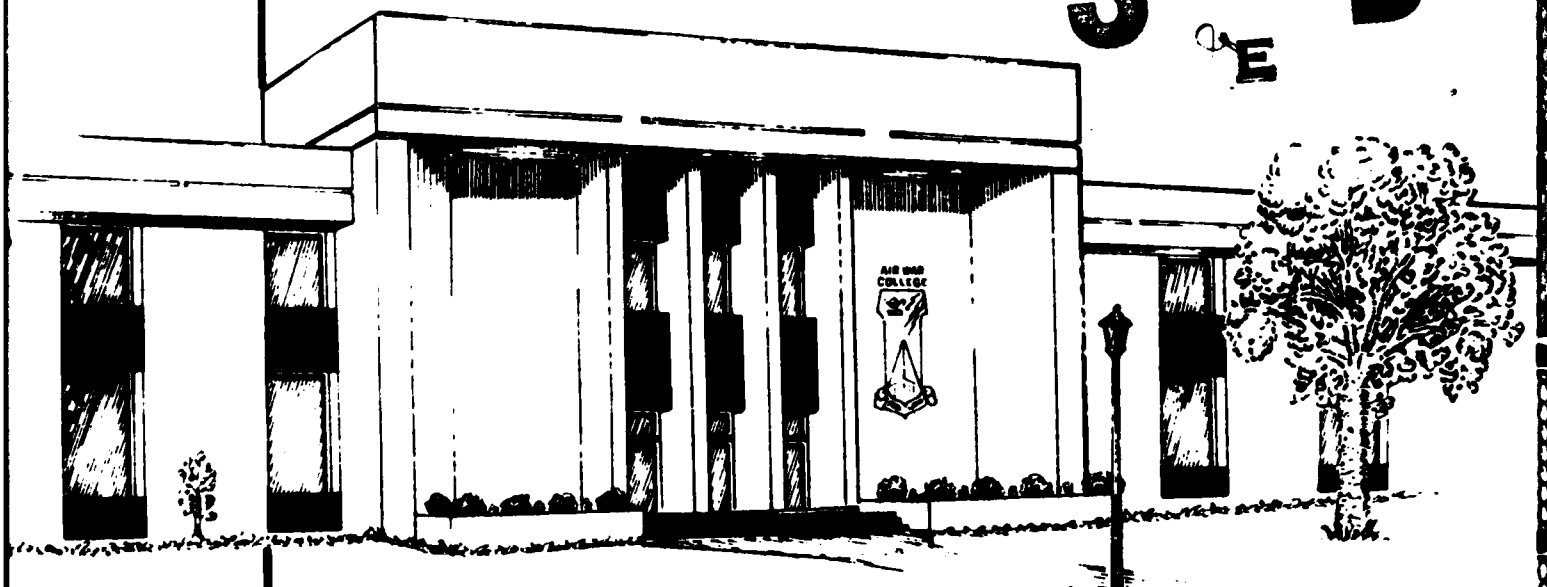
AIR WAR COLLEGE

RESEARCH REPORT

No. AU-AWC-87-070

A STRATEGY FOR SPACE WARFARE

By COLONEL ALFRED R. GARCIA, JR.



AIR UNIVERSITY
UNITED STATES AIR FORCE
MAXWELL AIR FORCE BASE, ALABAMA

AIR WAR COLLEGE
AIR UNIVERSITY

A STRATEGY FOR SPACE WARFARE

by

Alfred R. Garcia, Jr.
Colonel, USAF

A RESEARCH REPORT SUBMITTED TO THE FACULTY

IN

FULFILLMENT OF THE RESEARCH

REQUIREMENT

Thesis Advisor: Colonel Ted Schroeder

MAXWELL AIR FORCE BASE, ALABAMA

March 1987

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AIR WAR COLLEGE RESEARCH REPORT ABSTRACT

TITLE: A Strategy for Space Warfare

AUTHOR: Alfred R. Garcia, Jr., Colonel, USAF

Develops a strategy for space systems warfare that provides National Command Authorities with options that go beyond space systems. Examines policy, doctrine, and legal aspects of space systems, finds that more should be done in those areas. Postulates space systems warfare scenarios to include attacks on ground and control systems and covert and overt attacks on spacecraft; Analyzes present space warfare strategy using Fabyanic model and finds that present strategy is lacking in war fighting content. Finally, develops a new space warfare strategy with several options using Crowl's model and applies classical strategists. New strategy employs more elements of power than just space systems. Makes recommendations to correct several problems.

BIOGRAPHICAL SKETCH

Colonel Alfred R. Garcia, Jr., (MS, University of Southern California and MBA, Auburn University) has held operations, command, and staff positions over 13 years at various levels involving the Defense Satellite Communications System (DSCS), the Defense Meteorological Satellite Program (DMSP), and commercial satellite communications systems. After electronics systems officer training at Keesler AFB, MS, he served as maintenance officer at the Air Force Global Weather Central (MAC) at Offutt AFB, NB; commander of a weather equipment maintenance detachment (MAC) in Japan; inspector on the MAC/IG team, Scott AFB, IL; student, instructor, and staff officer in the 3300 TTW (ATC) at Keesler AFB, MS; chief, logistics plans (AFLC) at Hanscom AFB MA; commander of an Air Force Technical Applications Center (AFTAC) unit in Korea; chief of satellite operations at the Defense Communications Agency in Washington DC; and commander of the 1936th Communications Squadron (AFCC) at Lajes Field, the Azores, Portugal. Colonel Garcia is a graduate of Squadron Officers School (1972), Air Command and Staff College (1978) and the Air War College, Class of 1987.

CHAPTER I

INTRODUCTION

The United States is highly dependent on its space systems for its national defense. Space systems permeate DoD communications, command and control, intelligence, weather, and navigation functions and serve as treaty verification and force multipliers. (11:2,13-15) Space systems are among the best examples of US technology and its advantage over other nations. These systems also exemplify the overused term "force multiplier" by increasing the efficiency and effectiveness of DoD forces and weapon systems. Even in these few words it should be apparent that US dependence on space systems for critical defense functions should make these systems lucrative targets for any government wishing ill upon the US. It should also be apparent that with so much US dependence on space systems that these should not only be well guarded, but also built in such a manner as to be hardened or capable of defending themselves.

> For the forseeable future, the arsenal of weapons designed to shoot down satellites is likely to be more effective than any means to defend them. Thus, the advantage lies with the aggressor who shoots first and brings down the defender's satellite system as part of a general first strike. The aggressor need not initiate a full-scale nuclear attack in order to make the decision to hit the satellite system. Taking out the satellites could become part of a well-defined escalation plan to be executed in the event of a crisis. Thus it seems unlikely that the means for defending and hardening satellites will become good enough to change this situation any time soon, especially if the aggressor is

willing to use nuclear weapons. (21:24)

US space systems have few, if any, capabilities to withstand attack of any type. Although not every space system is vulnerable to all types of attack, each has its own set of vulnerabilities that can be exploited by technologically advanced nations. It should be pointed out that new and planned space systems are being built with defensive systems which should provide an improved ability to withstand postulated attack scenarios. (10:83) However, in the near term there is little that can be done to install defensive capabilities in space systems already fielded. We must develop a warfighting capability with the space systems that we have today.

The Problem

At this time the US does not have the capability to adequately detect, recognize, or respond to an attack on most, if not all, US spacecraft. Any response strategies that have been planned have not been agreed to by our National Command Authority. Most response strategies depend on technical solutions, but do not address any other types of responses across the spectrum of conflict that might be available to the NCA.

The Concern

Without a carefully thought out and developed response strategy, the US may be indecisive at a time when

its defenses are blinded, it is unable to communicate, or it is unable to receive sensor data. This indecision could be fatal to US interests.

Space Systems

It is first necessary to define terms and systems as they will be used in this paper. A space system in the context of this paper is composed of three elements: the space segment, consisting of the satellite; the ground segment consisting of antennas, power systems, and associated electronics; and the control segment which controls the health and status of the space segment and the ground segment. Although there are other ways to divide the functions, it should be understood that each space system has its own exceptions and blurrings of functions. (11:15)

This paper will use three space systems as examples. The Defense Satellite Communications System (DSCS) is a geosynchronous constellation of communications spacecraft providing common user services, specialized command and control services, and strategic and tactical support to commanders through numerous fixed and tactical earth stations around the world. The DSCS control segment is unique in its use of both user systems control as well as Air Force unique satellite control. The Defense Meteorological Support Program (DMSP) consists of two or more low earth orbiting satellites operating at a nominal 450 miles above the earth on a polar orbit. The satellites take swaths of visual and

infrared data as they sweep across the earth and downlink the data at predetermined periods to both fixed and tactical receiving terminals. The spacecraft are controlled through special earth stations. The third type of space system to be examined are the commercial communications spacecraft similar to the DSCS. These space systems support DoD requirements both in the US and overseas. In addition, these space systems provide the communications lifelines for international business and banking. Their major ground stations and control segments are generally concentrated in a few locations, particularly in most non-US countries. It should be noted that these space systems were specifically selected by the author because they each have essential characteristics of all space systems: high orbiter (DSCS and commercial satellite), low orbiter (DMSP), communications intensive (DSCS and commercial), sensor (DMSP), centralized control (DMSP and commercial) and dispersed control (DSCS). Because of these shared characteristics, much of this paper is applicable to most space systems.

Although this paper will examine the threat and the onset of hostilities in space, this paper will not examine why an attack is occurring. While this may be essential to developing a response strategy, it is beyond the scope of this paper to include all the reasons why an attack would occur against a space system. It must be assumed that the onset of hostilities will be based on a set of circumstances

that make war a possibility. "Bolt out of the blue" hostilities are probably not likely between rational opponents.

The author has used only unclassified materials to develop this study in the hope that this study might be useful in the public arena. Unclassified works are necessary for the debate useful in determining strategies for the US to fight a war in space.

Approach to Study

This study will first examine US policy, objectives, and doctrine on space operations and space warfare. This look at the unclassified documentation will be somewhat general in nature.

Secondly, this study will quickly survey the established legal aspects of space operations. The issues of sovereignty and militarizing space will be examined.

A postulated attack on a space system will be developed. This draws on scenarios considered in open literature and by the author. This chapter provides the framework for the threat and response to be developed.

An analysis of presently established strategic responses to an attack on space systems will be made. However, little unclassified is written on this subject.

Then a strategy for responding to an attack will be developed. This strategy will develop several non-technical response options that go beyond what is considered at the

present time.

Finally, some policy recommendations will be made that are intended to encourage development of non-technical options to defend US assets in space.

CHAPTER II

SPACE POLICIES, OBJECTIVES, AND DOCTRINE

> Notwithstanding a quarter century of space experience, the US today remains confused as to what its space policy should be, how it should think about the military uses of space, and how military space activity may affect national military policy as a whole. (14:94)

US Space Policy

Despite this gloomy assessment of space policy, it is evident that space policy has moved forward along with the development of a space program that is now somewhat well-defined. However, there is little consensus on space policy among the Executive and Legislative branches of government, the National Air and Space Administration, the Department of Defense, and academia. Serving as an excellent space policy background document, Croom has written a thorough analysis on the evolution of space policy from Eisenhower to Reagan.

In a 1958 "Preliminary US Policy on Outer Space" by the National Security Council, there were statements on the significance of outer space for the US, the establishment of a relationship between space vehicles and missiles, the use of space for manned exploration and for scientific and military purposes, and the need for international cooperation. (5:6-7) President Kennedy developed a pragmatic approach to space usage; he separated space policy

into both the public and the secret sectors so as not to inpinge the usage of reconnaissance satellites. The purpose was to ensure that no international agreements or forums caused the US to have legal problems. This approach inspired the secrecy endemic in the space business. (5:17-20)

President Johnson's administration was noteworthy in space policy because of three treaties signed during the period: the Outer Space Treaty which prohibited the orbiting of weapons of mass destruction; the Astronaut Rescue and Return Agreement; and the Nuclear Test Ban Treaty banning nuclear explosions in outer space. It was also noteworthy in attempting to apply international law to space. However, questions regarding flight operations in space, rights of transit, sovereignty, and application of international law were not addressed by new polcies or agreements. (5:23)

In 1972, President Nixon concluded two arms control agreements that "strengthened the legitimacy of space reconnaissance. Both the Strategic Arms Limitation I and Anti-Ballistic Treaties achieved, albeit indirectly, Eisenhower's long sought "open skies" doctrine." (5:30) The key was that neither the US nor the USSR would interfere with "national technical means" for verifying compliance with the SALT I and ABM treaties. By not specifically mentioning and excluding reconnaissance satellites, the space systems were legitimized. (5:30)

President Carter took a more aggressive approach on

space policy than one might have expected. Going public with his space policy, he rejected US claims to outer space sovereignty, supported the fundamental right to acquire data from space, declassifed space reconnaissance as a function of the US military, and, most importantly, declared that space systems "are national assets with right of access to and operation in space without interference." (5:35-36) Carter's Presidential Directive (PD) 37 gave strong direction to the US space program. It directed DoD to prepare plans to use civil and commercial space assets for command, control, communications and intelligence in times of national emergency. It further directed DoD to pursue space survivability, including developing a launch backup, protection against electro-magnetic pulses (EMP), maneuverability, anti-jam, and higher orbits. It also directed the development of an anti-satellite capability. (5:36-37) Despite its strong direction, PD 37 "emphasized defensive military support operations in space." (5:40)

> Taken together, Carter's space policy directives dramatically altered the direction and purpose of America's space program. Emphasizing military space programs before civilian space programs, they opened the way for greater military use of space. Approving development of the antisatellite system unquestionably altered the traditional goals of using space for non-aggressive military missions that did not restrict the passage of reconnaissance satellites. That alteration would require a rethink of the basic tenet adopted by Eisenhower and supported by every succeeding president: free international access to and movement in space. (5:40-41)

President Reagan's administration has not made major changes in existing space policy, except, of course, the President's famous pronouncement on his Strategic Defense Initiative. The 4 Jul 82 administration space policy made no mention of reconnaissance satellites, provided some evidence of increasing security levels of some systems, and approved the usage of expendable launch vehicles versus the use of the space shuttle. (5:43-44) However, the policy did clarify the US position on one issue: the policy claimed "the same sovereignty for space systems as for ships at sea." (3:6)

It is clear that US policy is to ensure that the US has free access to space. It is also clear that the US attaches importance to its access to space. Despite lack of support from Congress and the press, antagonism from the USSR, and budgetary constraints, the government has developed ASATs, a laser capability, and begun work on SDI. These efforts have indicated a willingness to take aggressive action to ensure the US has free access and survivability of its space systems. This has provided the DoD with the objectives needed to develop new and improved space systems. Although there have been constraints, these have been primarily through budgetary and Congressional controls that have limited developments. The budgetary constraints on DoD have resulted in careful optimization of future systems within budget levels. The Congressional constraints have been based on lack of understanding of US space policy, a

desire to apply treaty and international agreement provisions not always adhered to by the USSR, and cyclical funding profiles for the DoD between "feast and famine."

US Space Doctrine

Space doctrine is primarily contained in USAF directives. Air Force Manual 1-1, "Basic Aerospace Doctrine," defines the "aerospace environment" as "the total expanse beyond the Earth's surface...where Air Force forces can perform all of their missions." (26:2-2) As one aspect of the capabilities of aerospace forces, they can "...provide unparalleled observation of the Earth's surface...[and] continuously observe the activities of potential enemies and worldwide environmental conditions." (26:2-4) Emphasizing the similarities with other aerospace force capabilities, AFM 1-1 goes on to say that "Possessing speed, range, and flexibility, aerospace forces can monitor, report and react to potential adversary actions in both peace and war." (26:2-4)

As AFM 1-1 continues, it is possible for the reader to infer the use of space systems throughout the fundamentals and principles espoused. In the broadest sense, space systems do contribute directly to the employment of aerospace forces, although not constantly nor perhaps in all scenarios.

In Chapter 3 of AFM 1-1 there is reference to Aerospace Surveillance and Reconnaissance. The section

defines the objectives, the operational requirements, and the users of the systems. (26:3-5) Sections on "Warning, Command, Control, and Communications", "Intelligence", "Electronic Combat" and "Weather Service" indicate the usage of space systems, particularly in a defensive posture. (26:3-6,7,8)

AFM 1-1 does indeed provide basic doctrinal concepts on the usage and need for space systems. Its framework of integrating all of the elements of aerospace power in the aerospace environment provides sufficient guidance to develop more detailed doctrinal guidance concerned with space systems. The result is Air Force Manual 1-6, "Military Space Doctrine."

AFM 1-6 "...summarizes our national space policy, executive guidance, and both civil and military interests in space." (27:iii) It espouses that the "...basic philosophy of space doctrine is to preserve free access to and transit through, space for peaceful purposes by military and civil sectors." (27:iv)

Chapter 1 identifies "National space policy, executive guidance, and legal constraints." It addresses the principles of the US space program, specifically, the use of space for peaceful purposes, the rejection of claims of sovereignty, the rights of passage in space, and the pursuit of space for self-defense. (27:2) The executive guidance for the military directs the military to pursue survivability

and endurance of space systems, development and deployment of an ASAT system, development and maintenance of integrated attack warning systems to include protecting US space systems, and the securing of data from space activities. (27:3)

Chapter 2 addresses "Military interests in space" expanding on the direction in Chapter 1. Under responsibilities, DoD is challenged with the need "...for military activities in space and for defending US interests in and from the space medium," because "space assets are an integral element of the total force structure in all military areas." (27:5) It goes on to emphasize that "Increasingly, national security depends on our ability to operate freely in space." The military is challenged to "...defend friendly space systems by avoiding or surviving attack...conduct missions against critical enemy systems...[and to] ensure the continuing operation of critical US military space systems at all levels of conflict." (27:6)

Chapter 3 describes Air Force functions and missions in space in greater detail. Among other subjects, direction is given to "[increase] the effectiveness, readiness, and survivability of weapon systems...[negate] enemy attacks to, from, in, or through space...[and counter] threats to our support and warfighting systems." (27:7)

Doctrinally, this author believes that AFM 1-6 provides sufficient guidance for more detailed writing.

However, other authors disagree on whether or not the Air Force has a space doctrine. One author has pointed out that President Carter's PD 37 provides policy and AFM 1-1 provides sufficient doctrine. Although AFM 1-6 was not yet published, there was significant disagreement within the space community on definitions of doctrine, policy, and strategy. (9:6) Another writer confirms that doctrine for space has not been defined, partly because of lack of agreement on what doctrine means. (2:6-7)

Air Force doctrine is characterized by future thinking with much emphasis on programs, funding, future capabilities, systems, and technology. Although it does address the war fighting aspects of space systems, the emphasis in this area is for future war fighting capabilities. It appears that insufficient direction is given for war fighting today, as space operators and users await new capabilities for active and passive defense.

It is essential that doctrine be interpreted not only for the future, but also for the here and now. National space policy directs that space systems will be survivable, but the policy does not assign a timetable for results. Instead it appears to wait for a distant future when new technology will be available along with generous funding. The challenge is to develop a war fighting capability and deterence to attack with what is available today. Although there are shortfalls in technological capabilities, there is

no doctrinal statement supporting the development of deterrence using other than technological means. If indeed national policy and military doctrine are correct, then it is incumbent upon space planners, operators, and users to develop war fighting strategies to fight wars today with what is available today.

In a vein similar to the policy and doctrinal questions just addressed are the legal aspects of space and space operations. The legalistic environment within which the military operates today makes it necessary to review the legalities of military operations in space.

CHAPTER III

LEGAL ASPECTS OF SPACE OPERATIONS

Although much has been written on the legal aspects of space operations, sovereignty, and warfare, there are few actual agreements, treaties, or established bodies of law on the subject. Space law is evolving within international law. As Hosenball has inferred, the use of outer space should be conducted in accordance with international law. He establishes that several general treaties, the Nuclear Test Ban treaty, and the UN Charter "...incorporate by reference legal norms that have been accepted by the international community." He goes on to say that "No customary international law further limits military activities in outer space." (19:217) The conclusion can only be that there are no well defined limitations on warfare in space.

This section will survey international agreements that apply to space operations and will examine the two key legal issues on space: sovereignty and militarization of space.

Treaties and Agreements

Colin Gray's synopsis of key treaties and agreements applicable to the uses of outer space for military purposes serves as the basis for this survey. Although he describes nine treaties, only six will be examined here.

The Limited Test Ban Treaty of 1963 bans nuclear

explosions in space. (14:28) This ban has been followed by both the US and the USSR after the devastating effects on spacecraft by a US nuclear burst in space became known a few years ago.

The Outer Space Treaty of 1967 prohibits the orbiting of weapons of mass destruction, whether on a "celestial body" or a space platform of any sort. However the Treaty does not prohibit fractional orbits such as those used by missiles. (14:29) One legal authority asserts that "...the cornerstone of international space law is the Outer Space Treaty of 1967. This treaty is often referred to as the 'Principles Treaty' because it establishes general principles which constitute a basic charter for outer space." (25:19)

The International Telecommunications Convention provides for the regulation of frequency matters to prevent frequency interference. (14:29) In subsequent conventions, international frequency management bodies have also become involved with the registration of locations on the geosynchronous plane so that all users may be served. They have also established standards for satellite station keeping and frequency separations.

The Anti-Ballistic Missile Treaty of 1972 has several interesting aspects, but only two are directly applicable to this study. The treaty stipulates that neither the US nor the USSR will develop, test, or deploy ABM systems which are sea, air, space, or mobile land based. Importantly, the

treaty directs that neither nation will interfere with the national technical means used in treaty verification. (14:29)

The SALT I treaty, which expired in 1977, also emphasized the right of national technical means of verification to operate freely. (14:30-31) The legitimacy accorded the national technical means in two separate treaties clearly established their importance in treaty verification where no other means was agreeable to both the US and the USSR.

The SALT II treaty broke no new ground, but did reaffirm the use of national technical means of verification and the orbiting of nuclear weapons or any other type of weapon of mass destruction. New ground was broken by banning the development, testing, or deployment of weapons employing fractional orbits. (14:31-32)

The bottom line on using present treaties as the legal basis for space operations is that they don't really have direct applicability. Much must be inferred and much is left to interpretation. More definition is needed.

The Sovereignty Issue

Sovereignty is a major issue because it is one of the major similarities between space law (such as it is) and maritime law. There is agreement that an unmanned space object in space remains the property of the nation that owns the spacecraft, not the one necessarily, that launched it.

Because of this aspect, the spacecraft is like a ship at sea with the right of free passage in international waters and the right to move without interference. (25:56) In fact, the US' 4 Jul 82 space policy clearly establishes "...space systems of any nation to be national property with the right of passage through and operation in space without interference." The policy goes further: "Purposeful interference with space systems shall be viewed as an infringement upon sovereign rights." (14:66)

Part of the sovereignty issue is the question of a space zone around each spacecraft that would be viewed as a no-entry zone for other spacecraft. US policy is against such a "keep-out" zone. The issue is complex because if implemented, it would inhibit inspection of spacecraft either with manned or unmanned spacecraft. Most states would be sensitive about having another state remove, inspect, or seize space objects. (25:57) However, such a zone could provide some protection against space mines. Entry into the zone could constitute grounds for destruction of the intruder and a possibility of hostilities. Gray postulates that there is no legal basis for such "keep-out" zones. (14:66-68)

Militarization of Space Issue

Despite the public rhetoric about the peaceful uses of space and the need to keep outer space demilitarized, it is obvious that space serves critical military functions and is, indeed, a major arena for certain military functions.

The aspect that has caused the most public attention on the militarization of space is the anti-satellite (ASAT) weaponry. Based on the concept that space is a sanctuary, there is opinion that nations operating in space could reach agreement on not attacking each other's spacecraft under any circumstances. This concept is dismissed as "strategic fantasy" by one author. (14:10)

Another author states that "...space cannot be made a sanctuary through negotiations or treaties." He stresses that "...combat in space is inevitable." Finally, he believes that the US must have military superiority in space and that US dependence on space systems requires the US to prepare for combat in space. (20:17) Another proponent of the inevitability of war in space writes that "In the event of general war, the superpowers will fight in and for the control of space as they will fight everywhere else." (14:21)

At this time, there is little that can be done to alter the course of "militarization of space". Both the US and the USSR require space systems. Until ASAT, all space systems that were essentially military in function, were without any offensive capability. US interpretation of using space for "peaceful purposes" very specifically permits the development and deployment of military space systems as long as they are in pursuit of national security goals. The US has consistently interpreted peaceful purposes to mean

non-aggressive, rather than non-military. (25:20) It should also be noted that at the present time, the greatest danger to US space systems is ground based; electronic and optical devices could cripple space systems effectively today. Space, in effect, has already been militarized; the course cannot be altered.

Conclusion

The US has not taken an aggressive role in establishing a body of law for space. As a result there are ambiguities in most aspects of space operations that could negatively affect the US. The ability of small nations to influence space law could affect space operations and cause operational difficulties. Such matters as geosynchronous locations, use of the frequency spectrum, and the sovereignty of national systems need to be resolved.

CHAPTER IV

SPACE CONFLICT - POSTULATED

The idea of what space warfare might look like has been graphically presented by both the movie, Star Wars, and by the Strategic Defense Initiative, "Star Wars." In the far term, the graphics may be accurate. In the near term, however, space warfare should be much less glamorous. In this section, space warfare will be examined to include weaponry, tactics, impacts on systems, and recognition of attacks. One does not know accurately how war could be conducted, how effective the weapons would be, nor all of the possible impacts on damaged systems. However, it should be possible to develop a sense of what would happen. The three space systems to be assessed are the DSCS, the DMSP, and a generic commercial communications system.

Weaponry

Essential to discussion of space warfare is the consideration that it should be "space system warfare". All three elements of a space system are vulnerable: the space segment, the ground segment, and the control segment. One should not restrict thinking of weapons as "lasers at 3000 miles," but should definitely consider dynamite on antenna pedestals, electrical sources, and communications lines. It is reasonable to consider terrorist and unconventional warfare as being within the realm of space system warfare.

Probably the most serious space systems weapon available today is the electronic jammer.

> The ASAT arms control lobby has been guilty of focussing unduly upon explicitly ASAT-dedicated interceptor weapons. The facts of the matter are that electronic warfare probably constitutes a greater threat to the utility of satellites than do interceptor vehicles, and the Soviet Union has a commitmment to electronic warfare second to none in scale and scope. (16:24)

A jammer can perform uplink and downlink jamming, jamming of the control signals, and sidelobe jamming. (10:83) This type of weapon can be as simple or as sophisticated as the user desires. Designed for specific frequency bands, a jammer can perform spot, barrage, spoofing, and intermittent jamming. The skill of the jammer operator can dictate its effectiveness. Newer satellites being launched today have some anti-jam capabilities, but jamming can still result in degradation of capability, can cause disruption of systems operation, and will cause confusion among operators and users.

Ground and airborne lasers are essentially the same. These weapons are designed to either destroy the spacecraft by burning a hole in it or to damage a sensor or optical package by overtaxing its electronics. (1:83) Primarily useful today against low earth orbiters, lasers have the potential to cause permanent damage to the spacecraft. At the present time, lasers are the only present threat against

geosynchronous orbiting spacecraft, because of the inability of ASATs to reach high spacecraft. (1:180)

ASATs are among the most discussed space system weapons, because both the US and the USSR have developed ASAT systems. The US direct ascent ASAT is a collision device launched from an Air Force F-15 aircraft. (10:81-82) The Soviet ASAT is a rocket launched co-orbital interception-explosion device designed to acquire and destroy within two orbits. (10:82) ASATs at the present time are useful against low orbiters, but are not usable at geosynchronous altitudes. (1:174) The USSR is developing an ASAT for first orbit attacks which will cause the US difficulty, because of the lack of time to calculate the targeted spacecraft and the likelihood that the spacecraft would be attacked in a region where it would be out of US control. (1:162) ASATs have been designed to be highly responsive to current events and can be quickly launched. The US launch system is not currently detectable; however, the USSR's rocket launch system could be detected by US launch sensor spacecraft.

Particle beam weapons have been developed by the Soviets and were first tested in space in 1975. (1:214) These beam weapons develop a directed flow of high energy particles, such as electrons, protons, or ions; an acceleration device provides the high energy levels. However the beams require large power sources and can be deflected by

magnetic fields. They appear to be most useful in the ABM role as opposed to the space system warfare role. (1:206-207)

Other weapon systems that are of interest are the space mines and nuclear detonations at high altitudes. (10:83) Space mines would be launched into designated orbits and moved to either certain locations for future use or to locations where enemy spacecraft were located to be detonated at some future time. Considered a "hot kill" weapon, the weapon would detonate and destroy the target spacecraft with shrapnel. (1:170) Space mines should be easily detectable and their intentions readily determined. The launching country would be called to task for space mines. Nuclear detonations in space could be a problem. A 1958 nuclear detonation by the US under the designation, Project Argus, showed the devastating results of electromagnetic pulse (EMP) effects. (13:101) Neutron weapons are a new twist in that they radiate a satellite into destruction, but with a minimum of blast effects. (1:170)

Against ground and control segments, the weapon of choice for a ground based terrorist or special operations force would be the guided anti-tank missile. Useful against both antennas, operations buildings, and power supplies, an anti-tank missile can destroy almost any target and could be launched from a distance sufficient to avoid most security measures. Obviously, even more clandestine weapons are

available. However, because of the size of the ground and control facilities, it would be necessary to use fairly good size weapons to ensure long-term damage to a facility. Also it should be obvious that there are redundancies in the ground and control segments. System down time is the element bought by attacks against single facilities.

Scenarios for Initiation of Hostilities

Three scenarios will be presented here. They are by no means exhuastive, nor are they agreed to by many authors. However, these three scenarios will challenge the operational capabilities of the space systems under discussion.

Attacks on Ground and Control Segment

This scenario has been somewhat described; however more detail is required on the most lucrative areas to attack. Terrorist and unconventional warfare would target key ground facilities depending on the space system. Generally the easiest point to attack at an earth station are the antennas. They are usually in the open, especially the very large antennas, but may be under a radome. Visible from some distance away, the antenna if hit in the feedhorn assembly or any of the antenna drive mechanism could be put out of action for some time or could have its effectiveness significantly reduced. The soft skinned operations buildings could be a good target for a roof attack. Elimination of signal processing or communications equipments could disturb the capabilities significantly for a short to medium time

period.

An attack on ground facilities could begin as isolated incidents and masked by demonstrations. Disruption would be extremely effective for a short period of time until alternative operations could be set up. Unless there was an immediately obvious pattern of attack, it could be several hours before the full impact were assessed.

Covert Attacks

Covert attacks are the most insidious type of warfare, because of the difficulty in recognizing and responding to attack. Under his term of "disguised and anonymous warfare," Zlotnick describes satellite failure by natural or artificial means. In addition, he addresses reducing satellite life by making the space environment more hostile for the spacecraft. (29:43-44) Another approach would be "accidents" in space, a sort of "cold war" where things would happen, without much information or warning. (13:113) Certainly an easy covert attack technique is with electronic warfare. An intelligent adversary can produce signals that cause interference, induce thinking of spacecraft anomoly, cause loss of synchronization of signals, cause loss of computer and cryptographic timing and lock, and introduce errors into the system destroying data. The key to these attacks is recognition. Trained jamming operators against an unskilled adversary can cause havoc on signal processing. Responding to signal interruptions can cause

extensive troubleshooting difficulties for the untrained. The problem of locating where the signal interference is originating is impossible with most space systems.

A covert attack would begin with intermittent jamming signals on communications spacecraft causing disruption of sensor data flow to processing facilities and essentially blinding the US. While system operators were checking their equipment, the jammer would disappear before certain detection. A laser attack on low orbiters could take place as the spacecraft transits the USSR's airspace. A low level laser attack could cause degradation of data. Following orbits could also be attacked, furthering degradation of the sensors. Whereas it would be possible for system operators to suspect a laser attack, the skilled adversary could operate at such levels as to induce uncertainty of an attack and inducing thoughts of system malfunction. The net effect of these low level attacks would be a chain of perturbations in selected facilities that would cause short term disruptions and loss of confidence in existing systems. With careful timing the USSR could mask other activities as US sensors or communication channels were down for testing.

Overt Attacks

These attacks should be the easiest to detect. Bombing or armed attacks on ground and control segments by uniformed personnel should be obvious. Attacks in space would not be quite so obvious. The US' ability to track all

objects in space is well known. Presumably, enemy spacecraft, ASATs or space mines, would be known and followed from their launch to their use. The launching nation would be apparent. Particle beam and laser attacks might also be overt, because only one nation has the capability at the present time to perform these attacks.

Overt attacks on US spacecraft would clearly cause problems for both adversary nations. There is the thought that war in space would be "clean" and without direct human cost, and the "...posiibility of warfare without the involvement of civilians or even of soldiers is a new dimension in modern civilization." (29:32-33, 27) There is also the the thought that "...orbital conflict is conceivable, without necessarily triggering off a major nuclear conflagration..." (13:110-111) However the predominant thought is that an overt war would initiate a war of attrition that would result in one side gaining mastery of space. The loser would then be very vulnerable without his space assets. (13:117-118)

Recognition of Attack

Regardless of type of attack, recognition that there is an attack underway will be the single most difficult problem in space system warfare. Although a terrorist attack on a communications earth terminal would obviously be an attack, the context would be critical to determine if this were a precursor of a chain of events leading to conflict. A

sophisticated covert or overt attack would challenge space system operators to determine the problem.

At the present time with today's technology, there are numerous daily problems with space systems that cause some system downtime. These outages may be caused by hardware problems in the space segment, the ground segment, or the control segment. Despite .999 reliabilities, there are outages. The first response to any outage, despite the cause, will be to spend time quickly troubleshooting hardware. Increasingly, software problems in the many computers communicating with each other across the spectrum of DoD uses, have played havoc with downtime. These types of outages are extremely difficult to isolate and frequently look like they are caused by hardware faults. When timing and error detection software and hardware systems have faults, they are hard to separate. There are also natural anomolies that cause outages, such as solar flares and sun conjunctions. To the inexperienced operator, interference from these sources can look like electronic warfare.

Another problem with recognition is that a spacecraft anomoly is usually studied extensively by engineers before any determination is made as to the cause. Although there is a sense of urgency in the process of isolating the problem, the process is not responsive in times of conflict. The opinion that an anomoly has occured would have to be disproved before any credence would be given to an attack.

The reluctance of space systems operators to take any stand, firm or otherwise, has resulted in weeks long studies to determine problems.

Operator training at this time does not always include recognition of attack conditions. Electronic warfare is generally not taught, but has been learned by some operators through actual experience with interference situations. Inability to recognize problems until too late impacts the survivability of space systems.

Soviet Space Warfare Strategy

One of the key questions is the threat that the US faces. The USSR, despite public pronouncements, is keenly involved in military operations in space. One author has deduced that Soviet space strategy is based on the thought that "space is a warfighting arena and an extension of the terrestrial sphere of conflict." (3:69) Another author, in quoting a Soviet military journal, believes that in developing technological advances, they must "...promote achieving the element of surprise." The stressed goals from the Soviet journal included "...destruction of hostile reconnaissance means, since under present-day conditions, destruction of electronic intelligence gathering devices is of particular importance." The journal goes further "...neutralization and active jamming of the enemy's communications systems, leading to reduced enemy capabilities for exchange of information, troop warning, and control."

(23:51)

The Soviets have practiced extensively with their ASAT system; it works. Although use of ASATs would be an obvious tipoff to possible conflict, how much warning would be available and what decisions could be made based on an ASAT launch would be subject to debate. Going even further with a well stated problem, Gray writes:

> ...one should not neglect the attack planner's dilemma that ASAT assault against critical early warning and strategic communications satellites in geosynchronous orbit, on a militarily useful scale, would be akin to a declaration of war and would certainly have dramatic DEFCON implications for force generation. (15:144)

Impacts on Space Systems

Thus far this section has developed the thought that US space systems are vulnerable. The three space system examples will now be examined for their vulnerabilities.

DSCS

The DSCS carries common user AUTOVON, AUTODIN, and AUTOSEVOCOM traffic from CONUS to overseas units. It also handles command and control, sensor, and special user communications for numerous DoD and other users. An attack on ground stations could be extremely effective in disrupting communications. Some nodal ground stations are critical to connectivity, while other ground stations are virtually single user. In some instances, reconstruction would be extremely difficult, while in other instances the deployment

of a mobile satellite terminal could reestablish communications. An attack on a control facility would deny the DSCS its capability to respond to contingencies and electronic warfare.

An attack on the geosynchronous space segment using jamming techniques could be very effective on the older DSCS II spacecraft, but less effective on the new DSCS III spacecraft. However, intelligent jamming could cause momentary to lengthy disruption of traffic, particularly common user systems essential to normal DoD business. A physical attack would destroy a large percentage of DoD long haul intercontinental and intertheater communications. It would impact on tactical and intertheater communications. "Without the [communications satellites] war would quickly decay into an uncertain and spontaneous anarchy where control or direction was totally abandoned for 'last ditch' techniques." (1:153)

DMSP

The DMSP provides visual and infrared weather and sea information from its 450 mile altitude to strategic and tactical users, including all four military services. Physical attack on certain critical ground stations could have a devastating impact on strategic users because of a loss of control and processing capability. Because of the downlink only nature of the spacecraft, jamming of the satellite would not be effective, although sidelobe jamming

of receiver sites is feasible. Laser attacks could damage the sensors on board. An ASAT attack is feasible because of the low orbit.

The loss of DMSP would cause denial of essential weather and ocean information over vast areas of the earth where US forces operate. In addition, the ability to operate in these areas would be severely hampered affecting target and flight planning for various weapons and weapon systems. It understood that denial of weather information is a common practice when a nation goes to war.

Commercial Communications Satellite

The weapons used against this space system are essentially the same as for DSCS. Jamming would probably be more effective because of the lack of any anti-jam capability in these systems. Only recently have anti-jam appliques been applied to the control segment. Physical attacks on the ground segment would be fairly easy since many commercial facilites are readily accessible to the public with minimal physical security.

The impact of losing commercial connectivity could be tremendous. A determined enemy that desired to disrupt international communications could do so easily. It would be a simple matter to significantly disrupt business, banking, financial, stock market, and data traffic. The impacts could impact international relations, ruin businesses, and cause havoc in capitalistic societies. An intelligent jammer could

so disrupt communications that panic might ensue in many countries, with resulting financial panics, dollar, gold and silver price fluctuations, and bank ruin.

Conclusion

In establishing postulated attack scenarios and analyzing possible results and impacts of such attacks, the stage is set for response strategies. The next chapter will examine what is thought to be today's US response strategy to an attack on US space systems. The following chapter will develop a proposed response to an attack that will be more responsive and provide more options to National Command Authorities.

CHAPTER V

ANALYSIS OF PRESENT SPACE WARFARE STRATEGY

In searching for a written US space warfare strategy, it becomes obvious that little exists in open literature. There is little serious commentary on strategy beyond the level of technological responses to attack in space warfare scenarios. Current US strategy is aimed at the development of new systems and technologies for warfare in the next decade, essentially an acquisition strategy giving direction to planners and buyers of weapon systems.

Assumptions

Before discussing this author's thoughts on today's space warfare strategy it is useful to identify assumptions. First is the assumption that an attack on an element of the space system has occurred, whether it be on the space, ground, or control segment. Second is the assumption that the US has recognized that an attack has occurred; this is particularly significant of an attack on the space segment. The third major assumption is that the US knows <u>who</u> is attacking.

In a separate category of assumptions is the thought that there is an established chain of command and information flow that would allow the prosecution of space warfare. Although US Space Command has established procedures for reporting incidents from its most important facilities,

primarily sensor sites, there appears to be a lack of procedures for less critical sites such as DSCS communications and DMSP remote readout facilities. It is unlikely that incident information would flow at sufficient speed to ensure that space systems could be saved from attack or that a timely US response could be made. Since space warfare could, and would, happen at virtually the speed of light, it would be essential for there to be a ready capability to pass space warfare information.

Analysis

In analyzing a strategy, it is useful to have a framework that includes the essential elements that constitute a strategy. Well-known military strategist, Col Thomas A. Fabyanic, has presented a framework that suits an analysis of an existing strategy. It provides the essential variables that a strategist must consider and will be used in this paper.

Policy

The first major variable is policy; "...it establishes purpose and provides guidance for the use of weapon systems...and, eventually, the development and deployment of strategic systems." (8: 30) As mentioned earlier, the US has stated its policy on freedom of access to space and policy of non-interference in space. It has also defined a policy of recognizing space warfare as a possibility, but little is written on the actual conduct of

warfare or the integration of such warfare into the overall scheme of war in any scenario. US policy currently emphasizes planning for war in space, but goes no further. This lack of policy guidance on conditions for war, strategy, rules of engagement, or other needed broad guidelines hampers US space systems warfare strategy development. The lack of such policy belies the US dependence on space systems for communications, weather, warning, attack assessment and reconnaissance.

Doctrine

"...Doctrine is the compilation of principles or basic beliefs concerning the military utility of force, developed through experience or theory, which guide the actions of military forces. Doctrine thus establishes the intellectual basis for planning and executing war." (8:30) USAF has an excellent doctrinal package for the development and employment of future space systems. USAF has well learned its space system vulnerabilities and has ensured that future space segments are better protected against the postulated enemy threat. The new DSCS III spacecraft are hardened against nuclear effects, but only a few of its ground terminals and none of its control segments can withstand the effects of a nuclear induced electromagnetic pulse, much less a nuclear attack.

Conversely there seems to be disagreement on doctrinal reasoning for defensive and war fighting

capabilities to protect USAF space systems or to attack enemy systems. Future systems may well have new capabilites, but there is little agreement on what actions to either defend current space systems or to fight an enemy in space.

Doctrinal discussions have centered on whether or not terrestrial principles of war apply to space warfare. In most of the writings examined, the space segment is the only element of the space system under discussion. It must be assumed that the principles of war apply to the ground and control segments. One author has stated that the military theater of space differs from earth or near earth. He feels that space is so vast that even large items are hard to find, impacting targeting and navigation. In addition, weightlessness and the relational nature of speed in space will affect strategic thought. Finally, he feels that weapons effects will be different in space. Whereas nuclear weapons may have to be fairly close to have the desired destructive effect, some simple devices, such as sand or nails could have a devastating impact on a spacecraft. (28:20) Another author, however, strongly believes in nuclear effects in space. "...Three characteristics of a nuclear explosion make it effective in an anti-satellite role. These are the thermal flash from the fireball, hard radiation, and the electromagnetic pulse (EMP)." (22:80)

Other writers have written exhaustively on the application of the principles of war, particularly those

described in AFM 1-1. Those who have decided to espouse the principles of war have found them useful for doctrinal support. Friedenstein and Crotty, in their excellent applications of the principles of war to space, have provided a firm foundation for doctrinal development. It is not apparent to this author that USAF has taken advantage of this doctrinal foundation for its AFM 1-6, Space Doctrine.

Force Structure

Space systems have been uniquely designed to accomplish their various missions. From a strategy perspective, there is little doubt that the US has developed an effective, synergistic structure of space vehicles. Communications, attack assessment and warning, reconnaissance, weather, and navigation spacecraft have been noteworthy for delivering a quality product to users in a highly reliable manner.

However, there is substantial reason to believe that the ground and control segments of space systems have not been so well thought through. The ground segment is extremely vulnerable to various threats that have not been addressed, primarily because of the price of the fixes. Electronic warfare, electromagnetic pulse effects, and physical security make the ground segment least available when most needed by users. The control segment is characterized by highly centralized control concentrated in a few vulnerable locations and set up to serve the needs of the

control community for the control community. Although these situations have improved in recent years, the concentration of expertise in the "space community" does not augur well for operational responsiveness to space system users. The US Space Command is primarily interested in acquiring future systems as both an operator and as an advocate.

The US ASAT program is following two development approaches, both in tune with the US desire for a responsive near term and long term attack capability. The first is "...a conventional air-to-space heat-seeking miniature homing vehicle fired from an F-15 aircraft" and the second is "...directed energy weapons, especially high-energy chemical lasers." (24:72) The future ASAT force structure provides a balanced approach in the context of time and capability.

Technology

Without doubt, space systems are technology oriented. Although Fabyanic uses "technology" narrowly when he defines its usage in strategy formulation, it is still useful here. He says that "...technology [is]...the means by which one makes qualitative improvements in strategic systems. At issue here are not minor technological improvements in existing systems, but introduction of entirely new and usually complex systems...." (8:33)

Space systems are heavily evolutionary. Today, most changes in space systems are refinements and improvements in power systems, transmitters and receivers, and sensors. US

acquisition and planning strategies for new systems has taken advantage of technological advances both existent and future.

New space weapons, such as ASATs and lasers, and possibly the Space Shuttle, have caused thinking on how these weapons could be used against an enemy spacecraft. However, little thought is evident as to when these systems might be used, under what conditions, or the rules of engagement. A case can be made that the doctrine and strategy for the employment of these weapons lags behind the technology.

Despite the best in technology there is no assurance that any space systems will be foolproof and work without fail under any conditions, particularly war. A system that may be touted as the very best may not deliver in the heat of battle, a fact that cannot be determined by testing in laboratory or simulator conditions. Technology is not the panacea for all occasions and must not be relied upon totally.

Targetry

In targetry it is essential that the strategy identify those targets that will accomplish the military objective. (8:30) Other than enemy spacecraft there is no public evidence that the US has any enemy ground facilities targeted. The fact that there are enemy satellites and that the US has a satellite killer capability ensures that some thought has been given to targetry. At this time, low earth orbiting spacecraft are within reach of current weapons,

while geosynchronous spacecraft are not vulnerable today, except for laser attacks on some sensors and electronic jamming. Enemy ground and control facilities are located almost entirely within the sanctuary of the Soviet Union and would be extremely difficult to put out of commission without incursion with Soviet sovereign territory. Nevertheless they should be considered as worthwhile targets as part of the US response alternatives. It should also be noted that some enemy offensive systems are not in the Soviet Union. Offensive threats, especially jammers, are located in numerous places or are mobile, and could be neutralized relatively easily if they can be pinpointed.

However, which enemy spacecraft could be targeted which would get the enemy's attention? Because the USSR is less dependent on space systems than the US, the problem of targeting is made more difficult. If the US capitalizes on Soviet paranoia, then it becomes a simpler matter as some "eyes and ears" space systems could be destroyed, lasered, or jammed by the US. The net effect would be to drive the USSR to take some type of action or to desist from further action.

Threat

Although addressed previously, the threat against US space systems is well documented. Although some of the weapons capabilities granted to the Soviets may not be as capable as postulated, whatever capability does exist against spacecraft creates a threat that US strategists must consider

the loss of space systems at critical times. In addition, any number of countries have the capability to conduct small scale operations against US ground facilities overseas, whether unconventional warfare or terrorist activity. The threat is more complicated at some overseas facilities because some are critical to space systems. In addition, there is some redundancy built into almost every space system. The vulnerability of many communications links makes them lucrative targets particularly because of the critical role they play in command and control, attack warning, and reconnaissance.

The most significant aspect of the Soviet threat to US space systems is our reliance on these systems for so much of what we do and are responsible for around the world. Any threat against these space systems must be regarded as of significance to some aspect of US national defense and that of our allies.

In its response, the US attack strategy would rely on hitting those Soviet systems critical to their attack characterization, such as their sea surveillance and intelligence gathering space systems. Soviet paranoia must be considered in all attack scenarios to avoid an excessive Soviet response.

Leadership and Ideas

The ability to develop a strategy and implement its provisions requires the leadership to prosecute a war.

Charged with conducting space operations, the US Space Command performs the essential tasks of monitoring, managing, and controlling day-to-day operations for critical space systems. There is a leadership structure within Space Command that can perform warfighting tasks, including taking actions to protect US space systems and call for the use of US ASAT weapons. Lines of communications up the chain of command to National Command Authorities for key decisions and to lower echelons to implement decisions have been established. It can be assumed that there are plans for actions on what to do if a given event occurs. Although these capabilities are in existence for critical space systems, for some space systems such as DSCS, the remote DMSP sites, and for commercial systems, the mechanisms are not in place.

The DSCS space craft can be jammed; there is no direct line of communications to Space Command notifying of the problems. The DMSP, likewise, may not report anomalous operations until some time after the event. For civilian spacecraft, there are no routine links between their operations centers and Space Command. Because satellite control for DSCS and DMSP is highly centralized, any type of attack on the control segment should be known at Space Command almost immediately. The same is not true for the other elements of the ground segment, the earth station and readout terminals. Any attack on these facilities could

occur with a long delay before reporting to Space Command. The best leadership capabilities at Space command would be for naught because of a lack of information.

One aspect of starting afresh with the new US Space Command was the ability to encourage new ideas and new ways of doing things. This occurred, but was hampered by the desire of existing organizations to retain their control of their space systems as in the past. It will take some time for Space Command to provide the leadership necessary to have a coherent response to a space war that employs all US capabilities. One requirement essential to success is that Space Command leaders ensure full understanding of all aspects of the space systems and that they ensure that no personnel have a "fixation" only on the spacecraft, forgetting the control and ground segments. In addition, clear guidance is needed to avoid using only technological solutions to a space war and to ensure that options for other responses to attack are considered and presented to the National Command Authorities.

Society

Considered by Fabyanic to be the most important variable in any strategy, society and the pressures it engenders can play a pivotal role in formulation or implementation of strategy. (8:33) Despite governmental attempts at secrecy, the US public is aware of the many space systems in use by both the US and the USSR. While the US

public is aware of the uses of space, the public is probably not fully aware of their dependence on space systems for national defense and for their daily lives.

The large question for US strategists is what the US public would support in a strategy for war in space. It is difficult to make a conjecture, but there is little doubt that the public would be ill-informed of the problem. In this author's opinion, there would not be sufficient public support to enter a combative situation with the USSR over an attack on US spacecraft in space. A near term war in space would not engender the public support needed to cause the USSR to cease and desist from its attack. A spindly looking, unmanned, high technology spacecraft does not cause an emotion in the public to leap to its defense.

The lack of a well-publicized policy and strategy on space warfare has not helped the case for space warfare. Sophisticated opinion makers and some Congressmen are aware of US dependence on space systems and on US vulnerabilities yet; they have not come on line to demand strategies for space systems warfare. This is not a case for "canned" strategies, but a challenge to think through strategies from beginning to end, from advantages to consequences, from costs to benefits.

Time

A final variable in a strategy for space warfare is time. In developing a strategy the element of time may be a

critical aspect not previousy encountered by strategists. Space warfare can occur at the speed of light. Except for the need to launch and position ASATs, all present weapon systems can be turned on and off with the flick of a switch; there is very little time delay in prosecuting a space systems war.

Another aspect to the time variable is that because of the unmanned nature of the space segment, it would be possible to attack a spacecraft and not cause damage that would precipitate further warfare. A probing type attack could be performed without the need to escalate further. This option could allow the National Command Authorities the time needed to explore all options available to them. Today those options *do not appear* to be formalized in a strategy.

Assessment

In this analysis of US strategy for war in space, it is not apparent that the US has an organized, supportive, publicly acknowledged plan that will be useful in a crisis. Several important questions cannot be answered affirmatively: Will the American public support the onset of hostilities based upon an act of war in space and not involving men? Has the US military established the capability to unequivocally determine if an attack is taking place, who is attacking, and the impact of an attack? Does the US have a strategy that provides realistic response options to National Command Authorities to deter war in space or to cause cessation of

hostilities? Does the US have trained personnel to conduct a war in space using all available assets and capabilities?

Since this author believes that the questions must be answered negatively, this lack of a strategy to fight a war for space systems appears to be a dangerous shortfall in US military capability. The next chapter will propose a strategy to correct this situation.

CHAPTER VI

A STRATEGY FOR WAR IN SPACE

In developing a strategy it is necessary to draw upon classical strategists, current strategists, and one's own thoughts for new strategies. In much current military thought, there is the constant theme of wondering if the classical strategists are applicable in today's high technology, nuclear, and low intensity times. As a broad statement, all of the classical strategists and warriors are applicable in one way or another to space systems warfare. It is not the purpose of this author to apply each and every principle of war espoused by Sun-Tzu, Clausewitz, Liddell-Hart, etc, but to apply the philosophy of strategy, the situational awareness, and "big picture" aspect of the concepts of war. It is, above all, essential that personnel involved in space system warfare have the understanding and the sensitivity to the how and why of war, especially in a high technology environment.

Environment

> Should there be a general superpower conflict at any point from the mid-1980s to the end of the century, there will be warlike action in, and relating to, space. The "space warfare" activities that will be certain to occur in the event of a general war in this decade are the following: attacks upon satellites either by co-orbiting, exploding, "killer satellites" (the current Soviet ASAT program); by direct ascent exploding or homing vehicles utilizing missile or high-flying aircraft as launch platforms (the current US ASAT program) or by

> ground-based laser weapons; assault upon ground-based ASATs; attacks upon ground-based transmission, receiving, processing, and data relay satellites; electronic interference, jamming, of satellite "uplinks" and "downlinks"; attacks against, or electronic interference with, signal traffic between ground (sea and air) facilities for satellites and the ultimate users of that traffic; and the deployment and operational employment of satellite "survival aids." In the event of general war, conflict in space will occur. (16:5)

This prediction of future space systems war only misses the element of timing. At what point in war would space warfare commence? The evidence points to the beginning of hostilities or even before. US reliance on space systems dictates that the enemy would place high priority on US space systems as lucrative targets with the potential for blinding or restricting US command and control.

Assumptions

As in the previous chapter it is necessary to make several assumptions. First is to assume that an attack on a US space system has occurred. Corollary to this assumption is the second that the US has recognized that an attack has occurred. The third assumption is that the US knows who is attacking. Each of these are significant because of the inability to determine if they are correct. It is a major problem for most space systems to determine this information. because skillful jamming, signal interference or optical interference can be exceedingly difficult to recognize and interpret in the routine of daily operations. The DSCS III space system has the capability to detect and locate jammers

with some precision. The DMSP can be attacked from the ground and, depending on orbital location, could provide the location of the jammer. The commercial communications spacecraft are, basically, completely vulnerable. Physical attacks in space would rely on North American Air Defense Command tracking of spacecraft. NORAD could determine which nation launched the weapons.

Strategic Thoughts

It is appropriate to consider some words from the classic strategic and war thinkers and how their words apply to space systems warfare. First is to assess what the enemy wants to do against the US and what the US might desire to do against an enemy. Clausewitz writes:

> The dual nature of war...is expressed in two pairs of possible conflicts...: War waged with the aim of completely defeating the enemy in order (1) to destroy him as a political organism, or (2) to force him to accept any terms whatever; and wars waged to gain territory, in order (1) to retain the conquest, or (2) to bargain with the occupied land in the peace negotiations. (4:22)

The most likely objective of space system warfare corellates Clausewitz' words above. An enemy would seek to destroy or damage US "eyes and ears" which would cause the US to either accept any peace terms to avoid nuclear attack or to force the US from usage of space systems. Clausewitz also wrote:

> ...If you are to force the enemy, by making war on

> him, to do your bidding, you must either make him literally defenseless or at least put in a position that makes this danger probable. It follows, then, that to overcome the enemy or disarm him-call it what you will-must always be the aim of warfare. (4:77)

Space systems warfare offers interesting new possibilities for warfare that begin to validate yet another of Clausewitz's thoughts, that of a full range of warfare, not all leading to outright destruction:

> ...In war many roads lead to success, and that they do not all involve the opponent's outright defeat. They range from the destruction of the enemy's forces, the conquest of his territory, to a temporary occupation or invasion, to projects with an immediate political purpose, and finally to passively awaiting the enemy's attacks. (4:94)

Sun Tzu makes the point even simpler in his chapter on "Offensive strategy:"

> SUN TZU said:
> 1. Generally in war the best policy is to take a state intact; to ruin it is inferior to this.
> 2. To capture the enemy's army is better than to destroy it....
> 3. For to win one hundred victories in one hundred battles is not the acme of skill. To subdue the enemy without fighting is the acme of skill.
> 4. Thus, what is of supreme importance in war is to attack the enemy's strategy. (17:77)

If the above is true, then the strategist must consider the probabilities that war will begin in space. It is a "natural" place to begin, with the distinct advantages of relatively easy controllability, reduced damage, and little collateral damage. One author goes so far as to ask

"...will a war in space lead to war on earth...?" (12:137) If Clausewitz and Sun Tzu are correct, the best place to wage war and force an enemy to do your bidding may well be in space.

Although it is important to think of defense, it is paramount to plan for offense. US strategists and politicians discuss defense, with only minor reference to offense. While necessary to consider defense, it must not be the sole objective of military leaders. Offensive capability and thought are essential for credibility. Liddell-Hart is known for his strategy of the indirect approach, a strategy which fundamentally avoids the direct approach and depends on the oblique. (18:xix-xx) The strategy is to take "the line of least resistance" and in the psychological side, the "line of least expectation". (18:327)

Liddell-Hart emphasizes that all of the principles of war represent a duality, in that every principle has an opposite statement. This duality is central to his strategy of the indirect approach and should be a central feature of any modern strategy. (18:329) The indirect approach offers the opportunity for a defense oriented military to develop an offensive strategy that meets the requirement for talking peace, but thinking war. Another key Liddell-Hart thought is for the strategist to develop alternative objectives in case the enemy has developed the capability to blunt a primary attack strategy. (18:329) Finally, Liddell-Hart has

proposed a set of eight axioms that should serve the strategist or the tactician in the planning and conduct of war. These axioms are important for the development of a strategy for space systems warfare:

> 1. Adjust your end to your means.
> 2. Keep your object always in mind.
> 3. Choose the line (or course) of least expectation.
> 4. Exploit the line of least resistance...[as long as] it lead you to any objective....
> 5. Take a line of operation which offers alternative objectives.
> 6. Ensure that both plan and dispositions are flexible-adaptable to circumstances.
> 7. Do not throw your weight into a stroke whilst your opponent is on guard....
> 8. Do not renew an attack along the same line (or in the same form) after it has once failed.
>
> (18:335-336)

Reflecting on the writings of the classical strategists, a strategy for space systems warfare can be developed.

A Strategy for Space Systems Warfare

In the development of a space systems warfare strategy, this author will use Phillip Crowl's "Six Questions Without Answers" as the basic framework. (7:28-35) Crowl's questions apply the Socratic method to development of a strategy.

1. What specific national interests and policy objectives are to be served by the proposed military action? How great is the value attached to those interests and objectives, and what is their fair price?

It is in the US national interest to maintain peace and freedom for the US and other nations; to contain communistic and totalitarian governments; to maintain the status quo and to ensure that our allies are protected as needed; to maintain the strength needed to ensure the US has the capability to protect its national interests; and to support the freedom to use space for peaceful purposes, which includes all purposes except the conduct of war.

US space systems warfare strategy ensures that space is available to the military for national defense through the acquisition of information from reconnaissance, attack warning and assessment, communications, and weather information. There is little doubt that space systems are essential for US national defense. Therefore, space systems play an important role in ensuring that the US is able to maintain peace and freedom around the world and to assist US allies in their national defense. US space systems directly support US national interests and policies.

Because space systems are critical to national defense, they are critical to US freedom and are extremely valuable when examined in the context of interests and objectives. Space systems should be defended, and there are programs underway to provide that self-protection. Included in this is the aspect of deterrence to an enemy to cause that enemy to avoid attack on US space systems. However, today it is essential that National Command Authorities determine

which, if not all, space systems are the most critical and worth warfare. Although all space systems must be defended, a case can be made that not all space systems at all locations are equally critical and worth warfare. For example, non-redundant space systems would be worth war, such as the attack warning and assessment space systems and the reconnaissance space systems. Some space systems have, to a limited extent, commercial equivalents, such as weather space systems, and might not be worth warfare. The DMSP provides unique and tailored weather services to military tactical and strategic users in all services. Some space systems have commercial alternatives, but these alternatives cannot support the military requirements in capability, location, or timeliness. The DSCS would be extremely difficult to replace and much of the traffic transitting the DSCS is highly sensitive and related to the highest priority space systems. The most logical approach is to either designate those space systems worth warfare or to protect all space systems.

In keeping with US policy of free access to space, the US should ensure that US property in space be protected through deterrence, or, if deterrence fails, to penalize the enemy for such an attack. The penalties should range through the spectrum of no response to actual warfare.

2. Is the national military strategy tailored to meet the national political objectives?

A US military strategy attuned to the national

interests and objectives is essential; hardware and technology exist to accomplish this strategy. US strategy, should space system warfare commence, should be tailored to the threat, the type of attack, space or ground, and the severity of the attack. If an attack on the space segment occurs by an enemy ASAT, the US should have the capability to respond with a similar attack on a similar enemy space system. If the enemy destroys the US space segment, then the threat of the same should occur to the enemy system. If an attack occurs on US ground or control segments, then the political aspects may become very significant. The need for a "surgical strike" against enemy facilities may require the crossing of borders and the initiation of ground attacks. US response options might be restricted to attacks on space segments in the "no man's land" of space. Some response options could be accomplished covertly, while others could not; overt responses might be politically difficult. In addition, strategists must understand that not all response options are available against all space systems. ASAT is not an option against geosynchronous space systems, while lasers might not work against geosynchronous communications systems. Ground and control segments located in sanctuary areas might not be viable targets because of the cost of establishing an attack.

3. What are the limits of military power?

As mentioned above, there are limitations on military

power. First, only currently available weapons should be considered. Tomorrow's weapons are for tomorrow's wars. Second, the US has not matched the development of Soviet weapons for war in space. The USSR reportedly has particle beam weapons that might be usable against low earth orbiter space systems; the US does not have such capabilities. The USSR has highly developed electronic warfare capabilities that could wreak havoc on US communications systems, both military and commercial. Full US capabilities are unknown, although some electronic warfare capability undoubtedly exists or could be developed quickly. US ASAT capability is well developed and is simpler and faster to employ than the Soviet orbiting ASAT.

One of the key questions is how much damage needs to be done to discontinue warfare. Ideally no warfare would actually occur; but if war did commence, then damage should be limited as much as possible to avoid collateral damage and escalation of hostilities. US military power would undoubtedly be limited by political constraints on avoiding escalation. In addition, military planners would be challenged to assure the National Command Authorities that no collateral damage would occur. Without doubt, there would be great hesitation on the use of military power on the ground and control segments of the enemy, because of the political implications of such warfare. The impacts of warfare would have to be considered, to ensure that military actions were

worth the costs.

4. What are the alternatives?

The US has several options that could be used before the military option is used. First is to ignore that an attack has occurred. While this may seem implausible, the technique of not disclosing to the enemy that he has succeeded in causing difficulties can be a useful tool in confusing the enemy. If the attack is to be acknowledged, then diplomacy may be warranted to seek cessation of the attacks. Obviously, diplomacy must be backed with the strength to make good other alternatives. If it is decided to disclose US space system capabilities to withstand attack, then the US may employ those passive measures available to affected space systems. This may be as simple as changing frequencies, reducing sensitivity of sensors, or reducing look angles of antennas toward sanctuary jammers. Going even further, active defense techniques may include moving spacecraft to other, perhaps less advantageous, locations, or activating spare spacecraft to increase the constellation and compound attack problems.

Neutralization of enemy offensive space systems might be feasible if the decision to attack the enemy's ASAT could be made fast enough. US ASAT capability could be used against some Soviet ASATs if the orbit were close enough to US ASAT bases. A major advantage of an ASAT attack is that it would not be obvious to anyone except the two adversaries.

No interruption of service to existing systems would actually occur, yet a war could be "quietly" fought among weapon systems.

5. How strong is the home front?

In space warfare, the public would not be influential. This conclusion is based on three reasons. First, the speed of space warfare; there would not be enough time to build public support for a war as after the attack on Pearl Harbor in 1941. Secondly, space warfare would be fought by remote control between unmanned systems; there would be little to catch the imagination of US citizens. Finally, the public might not fully understand the implications of an attack on a space system that is not even publicly acknowledged by the government. By the time the public understood, the hostilities would either be over or have escalated beyond space.

Influential elites both in the private sector and in the government are aware of the implications of space warfare. Because of differences in approaches to challenges to US sovereignty between the conservatives and the liberals, it can be concluded that there would be vociferous debate over what actions to take, with little agreement on the final solution. The National Command Authorities would have the responsiblity to initiate a response to an attack on a US space system without the benefit of public support.

Having concluded the above, as part of a good

strategy, the US public must be informed of the possiblities of war in space and the potential results of such warfare. The US public is capable of understanding the issues, once they are informed. However, the final result may be a lonely decision for the National Command Authorities to make in a hurry without benefit of public consensus.

The question of whether or not space systems warfare would be a "just" war is moot. If space systems are critical to national defense and important for US national interests and objectives, then space system warfare would be "just" warfare. It is interesting to observe the debate over the Strategic Defense Initiative because of its defensive qualities. The SDI debate is instructive for its lack of consensus among the informed elite and the lack of interest among the uninformed. Except for budgetary issues, there is little debate over the concept of warfare in space, the doctrinal issues of a defense umbrella, nor the strategic impact of imbalancing the strategic theory of mutual assured destruction.

6. Does today's strategy overlook points of difference and exaggerate points of likeness between past and present?

The proposed strategy does not advance the ideas of warfare significantly, nor does it dwell on the past. It does, however, emphasize the need for a flexible offensive capability to ensure that US space systems are defended through deterrence. In reviewing the classical strategists,

it is their applicability and relevance to today that strikes the modern strategist. Liddell-Hart's strategy of the indirect approach is clearly an excellent approach to keeping space systems warfare under control and to meet military objectives. Clausewitz and Sun Tzu provide the basic thoughts for a strategy of controlled aggressiveness, yet with the basis for striking at the most critical targets and at the weakest points.

If the Soviet Union is the enemy to plan for, then their outlook toward international agreements and treaties must be taken into account. The Soviet's known penchant for abrogating agreements cannot be ignored in planning for space systems warfare. The USSR has not been open with its space warfare capabilities.

Technologically, the US is believed to be far ahead of the USSR in some types of space system warfare. The direct ascent ASATs, lasers, and passive defenses on some space systems provide the US with a small, but potent, arsenal against enemy space systems. The USSR's reported particle beam, laser and orbital ASAT capabilities provide them with a strong capability against low earth orbiters.

6 plus 1. What have I overlooked?

There are several things remaining to consider. First: what will trigger space warfare? Will it be a sneak attack or the result of increasing tension? Will there be time to do anything sensible before things go too far?

Secondly: Is there a system to pass information up the chain of command and decisions down the chain of command in a timely manner? Can the US carry out the decisions that are made? Will technology perform as promised?

Third: How will this strategy fit into the overall US military strategy? No military strategy can exist in a vacuum; will this space system warfare strategy mesh with the attack strategies necessary to destroy enemy ground and control segments in various locations around the world?

A Strategy: Concisely Stated

Rather than leave the reader with an ambiguous feeling on what the proposed space system warfare strategy really is, the author will attempt to concisely state the options to be used, including essential decisions. Assume hostile actions have commenced.

1. Determine type, size, and extent of attack.
2. What else is happening in the world?
3. Make decisions:
    a. Do nothing.
    b. Disclose vulnerabilities.
    c. Disclose effectiveness of attack.
    d. Decide which space systems to fight over.
4. Options to avoid war :
    a. Diplomacy.
    b. Passive defense.
    c. Other plausible options: economic pressure,

allies.

5. Options to make war:

a. Active defense.

b. ASAT employment.

c. Attacks on enemy ground and control segments.

d. Attacks on enemy space segment-non ASAT.

e. Other plausible options: embargo, use of surrogates.

In developing this simplistic strategy, it is necessary to remember that there is little written on the subject of space warfare strategy. This attempt at developing a strategy should serve as a beginning for more thought, discussion, and writing on the subject. Strategists must continue to develop the strategy to conduct war in space.

CHAPTER VII

CONCLUSIONS AND RECOMMENDATIONS

What will space system warfare look like? The most likely scenarios to occur in space system warfare might be the following: The first includes attacks on ground and control segments by small enemy raids or by terrorists. The second most likely attack is a covert attack on spacecraft primarily by electronic warfare or ground based lasers. These attacks would be difficult to identify and even harder to identify the perpetrator. The third type of likely attack is an overt attack by ASATs or space mines. This type of attack could be most easily recognized and the attacking nation most easily identified.

Present space warfare strategies do not adequately address warfare in the near term. Although there are excellent strategies for acquiring new systems and capabilities in future space systems generations, there are few non-technical solutions to warfare issues today. In analyzing present strategies, many key variables essential to a successful strategy are lacking in offensive thought. There are a lack of options for National Command Authorities to respond to threats to space systems. The US has only a limited capability to determine if an attack is taking place or who is attacking, thus limiting the ability to respond properly. The bottom line is the need to establish a viable

space systems warfare strategy that provides options across the spectrum of warfare.

A new strategy for space systems warfare should be centered around a strategy of the indirect approach. If space systems provide an arena for controlled warfare, both in scope and quantity, then it is an attractive locale for hostilities. A proposed strategy includes key questions to answer and decisions to make that involve information known and to disclose. Options to avoid war or to continue hostilities should be developed, from diplomacy to open warfare, both in space and on land. The US offensive strategy must be aimed at the enemy's center of gravity. The Soviet center of gravity in space is their reconnaissance space systems that monitor US activities. Offensive action against these systems would create the most suitable environment for meaningful peace discussions.

Space systems warfare will challenge military strategists and operators for years to come. The criticality of these space systems, their lack of defense capability, and their vulnerability to attack makes them lucrative targets. The space segment captures the imagination the most, but it is the hardest to attack. The ground and control segments are the easiest to attack, in most cases, but the most likely to have immediate political repercussions. The US National Command Authorities require a number of options to respond to the onset of hostilities of space systems warfare. It is the

responsibility of military strategists to meet the challenge.

The US has established its need for space systems. These systems are critical for national defense and for so much that the US is and does around the world. Military strategists must prepare for war in space. It is the next war zone.

Recommendations

As part of the challenge to military strategists, there are several recommendations. These recommendations need to be answered by professional strategists and operators.

1. The US must determine which space systems it will fight for. This extremely difficult determination must consider not only the mission of the space system, but also its vulnerabilities, its redundancies, and its essentiality at the time of advent of hostilities.

2. The US must develop the capability to recognize attacks on space systems with a high degree of certainty. For the space segment, operators must be able to recognize electronic warfare, laser warfare, and hostile acts by other space segments. Those control agencies must develop the techniques to assess anomolies and other indicators.

3. The US must have a long term plan to reduce space system vulnerabilities and to increase its active and passive defensive capabilities. Near term defensive capabilities need to be exercised with the intent of developing tactics

and planning for future capabilities. Although there are many technocrats available to build technical solutions for defenses, the strategists and operators must ensure that these defenses satisfy real world strategies.

4. In addition to military space systems, US strategists must consider the defense of commercial communications and non-military weather space systems. Consideration should also be given toward defense of some foreign commercial space systems that could prove useful in US overseas operations. A firm US policy toward critical commercial systems would ensure that international communications, as well as US domestic information systems, would be protected.

5. The US should continue to work toward an international body of law for space operations. If the US maintains a negative policy, then it will not be in a position to influence the formation of law. Many smaller nations have launched communications space systems and are establishing bases of power. The crowded geosynchronous orbits and frequency spectrum will affect operations of future space systems. In addition, infringements of rights in space should be adjudicated properly and to the benefit of all nations.

6. Training for space systems operators must include learning to deal with a threat environment. That training should be for operators of the space, ground, and control

segments, because each has its own problems and characteristics. The threats should include dealing with physical threats, electronic warfare, and laser/particle beam warfare.

7. Senior space system operators should be educated in warfare, including its principles, strategies, and doctrines. They should also have a keen understanding of how space systems fit into the overall US strategy and military operations, so that no space system operations are performed without considering the larger perspective of US strategy.

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